

**LEARNING OBJECTIVES:**

- 1.10.01 Describe the assumptions on which the current ALARA philosophy is based.
- 1.10.02 Identify the ALARA philosophy for collective personnel exposure and individual exposure.
- 1.10.03 Identify the scope of an effective radiological ALARA program.
- 1.10.04 Identify the purposes for conducting pre-job and/or post-job ALARA reviews.
- 1.10.05 Identify RCT responsibilities for ALARA implementation.

**INTRODUCTION**

All personnel at a facility must be committed to the ALARA philosophy. The RCT can play a major role in establishing and maintaining that commitment by understanding its concepts. This lesson will familiarize the student with the ALARA concepts and the essential components of an effective ALARA program.

*1.10.01 Describe the assumptions on which the current ALARA philosophy is based.*

**ALARA PHILOSOPHY**

ALARA is an acronym for As Low As Reasonably Achievable. This term is based on the belief that exposure to certain agents could cause undesirable effects. The concept also implies that there is a relationship between the amount of exposure and the possibility of an effect; there is a risk involved in receiving the exposure. The basis for the ALARA philosophy is quite simple; if you reduce your exposure to certain agents, you reduce the potential risk of an unwanted effect. This basic philosophy is used for a number of agents. Radiation is only one of these agents. Since RCTs are concerned with radiation, its effects, and maintaining radiological controls, we use the ALARA concept to maintain exposures at an acceptable level. We use this concept to help other workers understand why we sometimes place controls and limitations on the work they perform.

**WHY ALARA?**

The ALARA philosophy is based on the assumption that exposure to radiation (among other agents) poses a risk. The cautious assumption that a proportional relationship exists between dose and effect for all doses (non-threshold concept) is the basis for ALARA. There may be some risk associated with any dose. This is also called the linear model of exposure.

The effects of high doses of radiation delivered acutely are well established and characterized. The challenge is in determining the effects of low-level doses over extended periods of time. Studies have been performed over the years and are ongoing still.

The studies that have shown measurable results are those of atomic bomb survivors and individuals involved in Nuclear incidents. These have shown that there is a relationship between dose and biological effects. However, these effects are only measurable at the higher doses. At lower levels there are some people who believe that small amounts of exposure are actually beneficial. As a practice, it is a generally accepted practice to limit radiation exposure to reasonable levels and take a conservative approach.

**OBJECTIVES OF ALARA PROGRAMS**

The DOE and other regulating agencies have through their Orders and CFRs mandated that there should not be any occupational exposure of workers to ionizing radiation without the expectation of an overall benefit from the activity causing the exposure. All personal radiation exposure shall be maintained As-Low-As-Reasonably Achievable (ALARA).

Every facility and the DOE Complex, as a whole, will strive to keep radiation exposure to the work force and public well below regulatory limits and ensure that there is no radiation exposure without commensurate benefit. For a facility to meet its ALARA objectives it should first establish a program to maintain exposures ALARA. This program should be updated throughout the evolution of the facility. The program should consider:

- Design and modification of the facility and selected equipment and components to integrate the ALARA concepts.
- Updating the ALARA procedures and plans to reflect the current need of the facility.

- The availability of equipment, instrumentation and facilities necessary for ALARA program.
- Training facility workers and management as well as radiological control personnel in ALARA programs and reduction techniques.

## **ALARA CONCERNS**

Implementation of ALARA concepts should be carried out through all phases of a facilities lifetime.

ALARA Program concerns include:

### **Engineering Features**

- Discharge of radioactive liquid to the environment
- Control of contamination
- Efficiency of maintenance, decontamination and operations should be maximized
- Components should be selected to minimize the buildup of radioactivity
- Support facilities should be provided for donning and removal of protective clothing and for personnel monitoring
- Shielding requirements
- Ergonomics consideration
- Access control designed for hazard level
- Surfaces that can be decontaminated or removed
- Equipment that can be decontaminated

### **Area Arrangement**

- Traffic patterns to allow access yet prevent unnecessary exposure
- Equipment separation
- Valve locations
- Component laydown/storage areas

### **Operations**

- Inspection tour - access, mirrors, visibility
- Inservice Inspections - use of remote control equipment, TV, Snap on insulation, platforms, etc.
- Remote readout instrumentation
- Remote valve/equipment operators
- Sampling stations, piping, valving, hoods, sinks

**Maintenance Needs**

- Adequate lighting, electric outlets, other utilities
- Removal and storage areas for insulation/shrouding
- Relocation of components to low dose areas
- Workspace for maintenance personnel
- Lifting equipment
- Conditions that could cause or promote the spread of contamination, such as a leaking roof or piping need to be identified and corrected on a priority basis

**Radiological Control Needs**

- Access control
- Shielding adequacy and access plugs
- Temporary shielding and support structures
- Adequate ventilation
- Breathing air
- Contamination control - drip pans, curbs, drains, and routing
- Decontamination facilities
- Radiation monitoring equipment
- Communications

*1.10.02 Identify the ALARA philosophy for collective personnel exposure and individual exposure.*

**COLLECTIVE DOSE PHILOSOPHY**

When trying to adopt a conservative approach to reducing exposure to personnel it is important to keep two concepts in mind:

- Individual dose
- Collective dose

Individual dose is defined as the total dose received by a radiological worker due to occupational exposures. The DOE has established annual limits and each facility may have their own administrative guidelines to keep exposures low. It is extremely important for

workers to understand that regardless of the controls and administrative guidelines that are set in place, ultimately, keeping their exposure low, is their own responsibility.

Collective dose is defined as the total individual doses in a group or a population. This concept must be considered in the overall effectiveness of a program just as the individual dose must be kept in mind. Spreading dose among more workers versus higher individual exposures for fewer workers is a major ALARA issue. The DOE would like to see an overall reduction in both individual and collective doses used as the basis for determining the effectiveness of a facilities ALARA program.

While each DOE facility may handle the issue of collective versus individual dose differently, many situations may cause a facility to use both approaches. It is important however, that facilities avoid increasing the total number of workers to reduce the collective dose statistics. The focus should be on the reduction of risk for all workers based on sound work practices, current state of technology, economic factors, and social conditions. It is however, equally as important to ensure that exposure to other hazards has not increased as a result of lower exposure to radiation.

*1.10.03 Identify the scope of an effective radiological ALARA program.*

## SCOPE OF ALARA PROGRAM

The ALARA program must be incorporated in everyday, routine functions as well as non-routine, higher risk tasks. The involvement and commitment of all facility personnel, not just radiological control personnel, is also necessary to achieve the reduction of external and internal exposure.

For an activity to take place that includes exposure to radiation, the following conditions should be satisfied:

- The risks associated with projected radiation exposures should be small when compared to the benefit derived. This should be assessed for each activity.
- Further reduction in projected exposure is evaluated against the effort required to accomplish such reduction and is not reasonable.

### Ownership

Each individual involved in radiological work must demonstrate responsibility and accountability through an informed, disciplined and cautious attitude toward radiation and radioactivity. Every one has responsibilities in this area.

*Management responsibilities:*

- Design and implement ALARA program
- Provide resources such as tools, equipment, adequate personnel
- Create and support ALARA Review Committee
- Approve ALARA goals
- Design and implement worker training

*RCT responsibilities:*

- Perform the functions of assisting and guiding workers in the radiological aspects of the job
- Knowledge of conditions at the work site
- Knowledge of work activities to be performed
- Identification of protective clothing and equipment requirements
- Identification of dose reduction techniques
- During work conduct, maintaining awareness of conditions
- Correction of worker mistakes
- Response to abnormal events

*ALARA "group" - including facility/RC supervision/management responsibilities:*

- Evaluate worker suggestions and provide feedback in a timely manner
- Participate in pre-and post-work meetings
- Keep abreast of ALARA techniques pertinent to operations on site
- Track facility performance in comparison to stated goals

## **ALARA REVIEWS**

1.10.04	<i>Identify the purposes for conducting pre-job and/or post-job ALARA reviews.</i>
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To ensure the ALARA concepts are incorporated into radiological work, it is often necessary to conduct ALARA reviews. These reviews can be conducted in many different ways and each facility may have its own preferences. Regardless of what each facility calls them, they are an important part of maintaining exposures at a reasonable level. These reviews are called by various names, the following is an attempt to outline what they are and how they are used;

### **Pre-job ALARA Reviews**

For every task involving radiological work, sufficient radiation protection controls should be specified in procedures and work plans to define and meet requirements. Applicable ALARA practices shall be factored into the plans and procedures for each task or type of task. The practices shall be communicated to the workers through their supervision and Rad Con personnel to ensure that the worker is able to maintain their exposure ALARA.

Proposed ALARA protective measures shall be evaluated to ensure the costs are justified. This includes exposure cost as well as the financial costs. This type of review (Pre-job ALARA review) is usually performed by the ALARA group. The RCT may assist this process by supplying survey data to the ALARA group.

### **Pre-Job Briefing**

The RCT has more responsibility at the pre-job briefing. Pre-job briefings are held with employees who will be involved in work activities involving radiological conditions. The technician will identify the effective dose reduction measures for the conditions, where the workers should stand to reduce their exposure, routes to take to minimize exposure, contamination control techniques, etc. Also workers should communicate the needs of the job to the RCT, tools required, length of the job, system breaches, etc.

Procedures will be reviewed, worker qualifications are verified, emergency procedures will be discussed. The RCT should be the leader in this discussion, but should be flexible to allow input from all the individuals involved in the work. This should be a open forum where all questions need to be answered. By the end of the meeting, everyone should know what is expected of them, how to do it, and the conditions under which it is to be done.

To assist the RCT a ALARA pre-job briefing checklist may be used. This can consist of:

- 1) Scope of work to be performed
- 2) Radiological conditions of the workplace
- 3) Procedural and RWP requirements

- 4) Special radiological control requirements
- 5) Radiologically limiting conditions, such as contamination or radiation levels that may void the RWP
- 6) Radiological Control Hold Points
- 7) Communications and coordination with other groups
- 8) Provisions for housekeeping and final cleanup
- 9) Emergency response provisions.

### **Post-Job ALARA Reviews**

Jobs determined by procedure and by unusual circumstances may require a Post-job ALARA review. This will ensure the overall effectiveness of job planning and implementation. These reviews are handled usually by the ALARA group. The RCT will participate by giving survey data and their opinions on how the job was performed and ways it may be performed better in the future. It is important to note that the good portions of the job must be stressed. This process is not just for the things that went wrong.

Unusual exposure events are investigated in this process to determine the root cause of things that did go wrong. Recommendations are made and corrective actions are then taken to prevent future reoccurrences of these events.

### **Post-Job briefing**

A post-job briefing gives the RCT and the workers the opportunity to critique the work performance. Although this will not affect the dose already received for a particular job it can be effective tool in reducing the doses that may be received the next time that job is performed. The information discussed at post-work meetings may include discussions of what went wrong and what could have been done differently to reduce the exposures received as well as what went right. The workers want to hear the good aspects of a job. This will help reinforce good practices so that they will continue to do them in the future. The Post-work briefings rely heavily on the input of each worker for information on how best to reduce exposure the next time that job is performed. Typical questions asked a post-job briefing are:

- 1) Were there any problems performing the job in accord with the procedure?
- 2) Did you have the tools and equipment needed to perform the work? Could special tools ease the job?
- 3) Were there any unexpected conditions noted during the work? Could these conditions have been anticipated?



- 4) Were there any unexpected delays in the performance of the job? What was the cause of the delay?
- 5) Was temporary shielding used? Could the use of temporary shielding reduce exposures received for this job?

Do not limit yourself to just these questions. The briefing should be a dynamic exchange of information between all parties.

## RADIOLOGICAL CONTROL TECHNICIANS

### *1.10.05 Identify RCT responsibilities for ALARA implementation.*

The responsibilities of the Radiological Control Technician are many concerning the ALARA program. The RCT should participate in the ALARA Review process. The RCT can be instrumental in Pre-job briefings or reviews. They may help in identifying Radiological concerns and hold points. They could also assist in:

- 1) Tool and equipment requirements
- 2) Area Set-up
- 3) Worker preparation
- 4) Conduct of the job

The RCT is tasked with assisting other workers in maintaining their exposures ALARA. The RCT must be aware of their own exposure reduction needs. The RCT is expected to observe the worker to ensure that the radiological control requirements pertinent to the hazards present are taken and followed properly.

If the technician notices the worker not following good radiological work practices, on the spot corrections should be made. The technique that the RCT uses to convey problem corrections to the worker will have a direct bearing on the effectiveness of the correction. Do not talk "down" to the worker. Treat them as equals and explain your reasons for the change. This will be more effective than yelling or bossing the worker.

The RCT, however, does have Stop Work Authority. This is granted to all employees and all radiological control personnel. It is not something to be used lightly. The Rad Con Manual states three reasons when to exercise this authority when:

- 1) Inadequate radiological control
- 2) Radiological controls not being implemented
- 3) Radiological controls hold point not being satisfied

Before the RCT stops a job all the ramifications must be considered. It is important to keep in mind that SAFETY is ALWAYS the first concern.

#### **REFERENCES:**

1. **NCRP Report No. 91** (1987) "Recommendations on Limits for Exposure to Ionizing Radiation"
2. **DOE N 5400.6** (June 1992) "U.S. Department of Energy Radiological Control Manual"
3. **DOE Order 5480.11** (1989) "Radiation Protection for Occupational Workers"
4. **ICRP Publication 37** "Cost-Benefit Analysis in the Optimization of Radiation Protection"